SMART VENDING MACHINE COUNTER USING IOT

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DEDICATION

This master project report is dedicated to my father, who taught me that the best kind of knowledge to have is that to be learned from the life. It is also dedicated to my mother, who taught me that even the largest task can be accomplished if it takes first step.

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ABSTRACT

The availability of vending machine has become imperative for human as they depend on it to access products conveniently. Customer satisfaction and minimizing the expenses is one of the biggest challenges to the company by working on all details of the vending machine.

Keeping the vending machine always full with the stock of inventories is hard to keep because the distances between the vending machines and the supplying company needs huge expenses, so it affects the customer satisfaction when it runs out of stock. For the sake of obtaining both customer satisfaction and minimizing the expenses is by keeping the vending machine always full of its products stock as well as and reducing the expenses we need to work on smart vending machine.

This project presents smart vending machine counter using IOT. The developed system count the sales of the products in the vending machine and stores the data in an IOT platform called ThingSpeak platform in real-time.

This prototype system consists of two parts namely: hardware and software. The hardware part consists of ESP8266 NodeMCU, IR proximity sensor, DC motor. The software part on the other hand consists of ThingSpeak platform, Scetchware and Wirepusher.

The results can be shown the real-time sales of each product in the vending machine (VM) prototype. The prototype was built and tested to collect data for 12 days and analyse these data. Moreover, it shows the development of vending machine mobile application that is used for monitoring as well as getting notifications or alerts when the products is about to be out of stock.

Finally, the project design and built conclusion has successfully been able to monitor the stock inventory (SI) in the vending machine in real time so as to reduce expenses and enhance the customer satisfaction. It is considered a novelty that the smart vending machine counter was able to achieve all the targeted objectives and provide an effective smart counting system using IOT technologies an the innovations of

Thinkspeak interchangeability with scetchware and wirepusher systems. The project was successful in managing to integrate, embed and synchhrnoize all the IOT technologies alongside IR sensor technologies in the form of fully integrated sophisticated smart system. Our system and project modality will be very beneficial to all the manufactures and producers of vending machines industries and businesses.

ABSTRAK

Mesin layan diri sudah menjadi keperluan kepada pengguna mengakses produk dengan mudah. Antara cabaran besar yang perlu dihadapi syarikat mesin layan diri adalah kepuasan pelanggan dan penjimatan kos.

Bagi memastikan mesin sentiasa mempunyai stok inventori, syarikat perlu mengeluarkan perbelanjaan yang besar kerana, jarak antara pembekal dan mesin layan memerlukan kos pengangkutan yang besar. Kekurangan stok akan mengakibatkan pengguna kurang berpuas hati akan servis yang ditawarkan. Demi menjaga keuntungan kedua-dua pihak, adalah penting untuk sentiasa memastikan mesin layan diri sentiasa mempunyai inventori dan minimumkan kos syarikat, mesin layan diri pintar seharusnya diperkenalkan.

Projek ini memperkenalkan mesin layan diri pintar menggunakan IOT.Ia diprogramkan untuk mengira hasil jualan mesin pintar dan menyimpan data dalam platform IOT digelar 'ThingSpeak' secara real time.

Prototaip sistem ini terdiri kepada dua bahagian, "software" dan "hardware".Bahagian software terdiri daripada ESP8266 NodeMCU, sensor jarak IR, motor DC. Bahagian perisian di sisi lain terdiri daripada platform ThingSpeak, Scetchware dan Wirepusher.Hasilnya boleh ditunjukkan jualan masa nyata setiap produk dalam prototaip mesin layan diri (VM). Prototaip ini dibina dan diuji untuk mengumpul data selama 12 hari dan menganalisis data ini. Lebih-lebih lagi, ia menunjukkan perkembangan aplikasi mudah alih mesin layan diri yang digunakan untuk pemantauan serta mendapat pemberitahuan atau amaran apabila produk tersebut akan kehabisan stok.

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INTRODUCTION

1.1 Background

IoT (Internet of Things) and Sensors Technologies

IoT was first presented in 1999 by Kevin Ashton, in which it was applied in Supply Chain Management (SCM), [1]. At one point or another, the most extreme frames and gadgets, as well as the fabrics around us, will be transparent or possibly available on the current working system. In order to communicate with the IoT, many developments in the placement of sensors will be generated and provided, such as radio frequency identification (RFID), [1].

Necessity of IoT

IoT seems to be more and more known step by step due to the more extreme use of broadband. The use of the costs of the Internet of Things association can be reduced by Wi-Fi associations, worked in the sensors of gadgets and in the most extreme number of gadgets associated with a typical support. Via the IoT, the availability of the Internet can be obtained thanks to usual gadgets such as the workspace and smartphones and tablets for another domain with gadgets and ordinary things that use installed innovation to communicate and collaborate with external circumstances, throughout the Internet. These things are not universally usable gadgets, for example cell phones and PCs, but objects with a capacity for example vending machines (VM), flying engines, and a multitude of different models. This will significantly influence the economy by transforming different businesses into automated organizations and unraveling new action plans, improving efficiency and developing employee and customer engagement. Again, the strategies in which companies can grab compensation are arbitrary.

Vending Machines (VM)

Vending machines (VM) ordered in different types because they are designed for different points and applications (Musni, 2014). Vending machines are rarely available on the market. Vending machines offer various items such as snacks, drinks, water, tickets and other items. They also have many advantages. Objects equipped for distribution are therefore called "marketability". This means that things or administrations that can be sold are considered potential sellers. Basic products, snacks, fuel, ATMs, appointments for almost all types of administration and applications for almost all types of goods: they can all be considered "salable" for a kind of intermediate store with a pharmacy that distributes the doctor who recommends the medicines [3].

Within these first-rate innovations, information and correspondence structures are intangibly incorporated into customers. In addition to SCM, the IoT can be used in the same way for various applications such as therapeutic administration, public services, transport, observation, etc. proceed as in the past, [1]. One of the useful initiatives that can include the IoT framework is Vending Machines (VM). There is credibility for shielding and shielding certain vending machine parameters, such as controlling the fluid element in the machine, so that it is then possible to fill that machine with the necessary things and things right away let it run out. In addition, it is conceivable to test the frequency at which the machine is likely to be used, as a function of time. When the customer picks up the part in the vending machine to, for example, buy a can of coca, the possibility that the individual installs the part in the machine to buy coca, when the withdrawal of the part can be recognized and identified by an infrared (IR) sensor. [4]

VM and IoT Operability

Organizations of all classes recognize the essence of creating and using an IoT strategy. For some, this institution accepts the embodiment of promoting articles because they create direct obligations linked to the IoT. While this is extraordinary news for buyers of the latest candy machine facilities, many managers have huge fleets of vending machines with a long lifespan. These administrators need approaches to navigate vending machines, particularly in certain parts of the warehouse. The acceleration of the Internet of Things has directed to an explosion of sensor registering stages. The degree of unpredictability and uses of IoT gadgets

differs from basic gadgets in vending machines to multifaceted, intelligent man-made consciousness (AI) in shrewd vehicles and automatons, [5]. VM that is working with IoT can be named as VM.

1.2 Introduction

Vending machines (VMs) generally work in regions where data transfer capacities are conflicting or expensive, e.g. B. in open travel scenes, arenas, stops or shopping centers. Such zones destroy cloud-dependent IoT schemes with the ultimate goal of preparing information corners [6].

In an intelligent vending machine, the customer can organize items using a PDA without having to work with the confectionery machine. Counting the finesse of a machine increases the unpredictability accordingly. As the cost of sensors continues to decrease, it is important to equip an entire office with sensors in every rack, in every room or in every winding. In addition, programming forms and configurations require regular updates. These considerations arouse the interest of retailers who want to modernize existing confectionery machines for the world today. [5]

The emerging era of canned food machines offers tremendous opportunities for business change thanks to progress (IoT) and cloud technology [4]. VM providers and managers can increasingly expect successful approaches to customer loyalty, increase transactions and save money through remote management and confidential maintenance. By reviewing the information you enter, you can improve the right machines and inventory in each area, as well as important knowledge about progress, estimation, area, climate, season and other factors. [4,5,6]

1.3 Problem Statement

With traditional vending machines, information is collected when machines are restocked and serviced. This creates a serious delay in inventory monitoring. It also impacts sales reporting compliance in jurisdictions requiring vending machine operators to report taxes on sales on a timely basis. Infrequent visits also make it hard to know when a machine is malfunctioning and losing sales. Traditional vending machines require service visits to update prices or begin a promotion, such

as two-for-one deals. Since many vending machine owners rely on third parties to stock machines, there is no safeguard to prevent the vending of unauthorized products. The vending machines would experience downtime issues periodically. Sometimes they'd be entirely offline, while other malfunctions might leave the vending machine still functioning, especially when inventory run out of stock. Every minute of downtime was money the company is losing [1,3]

This is a paramount problem especially when the company is completely in the "Blackout Status" and keep sending their workers and sales people to find out and check the inventory status. This is completely a waste of time, money and deficiency in their sales capability to generate. Their Point of Sale (POS) of every vending machine will be highly deteriorated due to the above causes.

1.4 Research Objectives

1. To develop a remote monitoring to the vending machine (VM) that the machine admin operate utilizing the domain of Thingspeak platform for Internet of Things (IoT) technologies and VM mobile innovations.
2. To analyze the quality of sales by remotely monitoring the exact status of their stacking inventory (SI) inside the vending machine using Thingspeak platform.
3. To design and build IoT vending machine stacking inventory (SI) mechanism that will detect rapidly the stocking of the items within the machine and report back to the machine admin.
4. To enable the machine admin to do network monitoring for the machine, displays the stockings and reports back on real time to the company server by alerting the company that the VM is out of stock using the integration of wirepusher mobile application and Thingspeak.

1.5 Research Questions

1. What are the necessary steps to save unnecessary cost that the company will incur by sending employees to every vending machine (VM) that the company operate?
2. What will be the quality of customer service that the company offer by remotely monitoring the exact status of their inventory inside every vending machine?

3. How to design and build IoT vending machine mechanism that will detect rapidly the stocking of the items within the machine and report back to the company?
4. How to assist the company to do network monitoring of the indoor environment of the machine, displays the stockings and reports back on real time to the company server by alerting the company that the VM is out of stock?.

1.6 Project Scopes

The following applications were identified to be developed as part of the solution as a scope of the project.

1. Open software like ESP8266 NodeMCU will be setup in the implementation in order to get an affordable solution. The system requirements for remote monitoring is control application will run on the vending machine itself, gathering data from sensors and handling operation of the electromechanical aspects of the solution (e.g., turning the vending coils) as well as data exchange with both human users (e.g., customers and administrators) and with the cloud.
2. The VM company and their staff would be able to launch an IoT system that monitors the condition of their remote equipment from any internet-connected mobile phone or computer so as for the company to know the status of their inventory management.
3. Administration application will operate on a PC or tablet and allow for a detailed view into the operation of the vending machine, including events, status, and logs, as well as access to the cloud data and analytics. This application will report back to the data base of the company that stocking of that particular machine is lacking or no stockings status or certain percentage volume.
4. Each VM will be given a certain index number to be defined and identified. The reporting status of that particular VM will deliver to the company database the status of that identified VM. This can be depicted in Figure 1.1 [5]

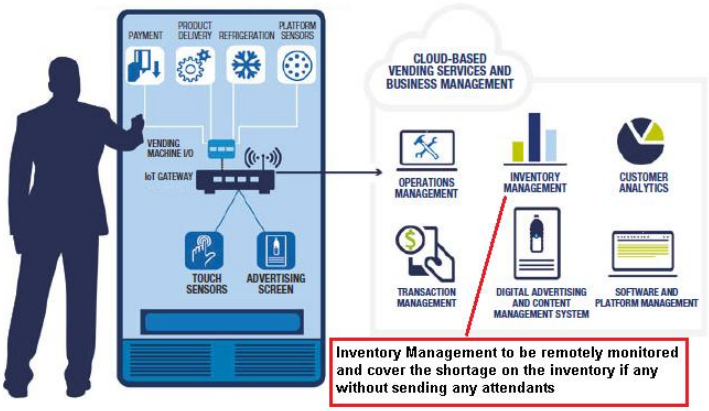

Figure 1.1: Vending Machine (VM) with IoT operability including inventory management option [5]

1.7 Motivation of the Project

These promises emphasize how innovation brings joy to our hearts in our daily lives, which will be increasingly beneficial. Many people buy dessert machine stuff but occasionally they shop and find that the vending machine is not available. This will result in customer dissatisfaction, reflecting terrible meetings. Vending Businesses Occur at point of sale (POS). Again, the organization is unaware that stocks are running out, as there is no effective framework for remote overhaul. The task is to create a highly disturbing vending machine with a sensor system and engine to insert into the dessert machine. The system checks the internal state of the machine, checks the blocks, and re-reads the organization's continuous server, alerting the organization that the vending device has expired. The device and the phone share their information via Bluetooth. This framework enhances better, personalized management with the organization by providing a good way to support distribution with machine owners and employees who benefit from IoT advancement on existing machines.

Our sensor exchange structures allow organizations to broadcast stages of the Internet of Things and remotely check the status of their tools or other equipment by: Reduction of labor costs associated with manual control techniques.

• Improves customer loyalty and customer service by delivering extremely proactive customer service without increasing costs.

• Reduce hardware maintenance costs by early detection of hardware failures and tool maintenance issues.

Extend the lifecycle of cost-effective components by pushing firmware programming / updating of multiple appliances over a wide geographical area.

1.8 Thesis Structure

This research thesis encompasses five chapters as follows:

Chapter 1 presents background, introduction of IoT with Vending Machines. Then it proceeds to identify problem statement alongside research objectives, research questions and scope of the study.

Chapter 2 furnishes comprehensive literature review about vending machines or related work, previous researches that were conducted in the same domain of VM with sensor and IoT technologies.

Chapter 3 delivers a detailed description of the research methodology that will be executed through the course of this research project. This chapter will discuss Adriano environment, tools and computations.

Chapter 4 analyses and discusses the results obtained throughout chapter 3 by evaluating the results and final findings. Then it proceeds to offer and pinpoint its novelty as part of the research work contribution towards vending machine IoT driven sensor technologies and real time stockings innovations.

Chapter 5 outlines and offers the final project conclusion, layouts the recommendation and suggests some views for further future research work investigations.

CHAPTER 2

LITERATURE REVIEW (LR)

2.1 Introduction

Chapter 2 presents the overview of the remote monitoring of vending machines development and their correlations with IoT and sensor technologies. The chapter proceeds to present a comprehensive literature review (LR) of the most relevant research papers, articles, journals and academic investigations about this topic. The final section of this section will be a conclusion and summary of related work research and development.

Chapter 2 is devoted entirely to reviewing literature relevant to the topic of remote monitoring of vending machines using ESP8266 NodeMCU embedded within IR sensor communication. The first section outlines the challenges identified with respect to that of vending machines and their kinds and its relevant applications. This is achieved through discussing relevant strategies in terms of policy, practice and research methodologies as well as research design that have been implemented. The chapter will conclude its discussion with the summary and final concluding marks.

2.2 Introduction to Vending Machine

The vending machine is a machine that distributes things, e.g. Snacks, drinks, spirits, cigarettes, tickets, which are guaranteed to the customer naturally after the customer [7]. These machines are probably used in various areas, such as companies, modern businesses, shops, associations, etc. Standard machine in the chamber with coffee powder or coffee beans, sugar and milk powder. The heated water chamber is also installed [7]. Vending machines (VMs) usually operate within the limits where transmission capacity is capricious or excessive, e.g. open stages, arenas, highway

stops or shopping mall passes. These areas only confuse IoT rules depending on the cloud with the ultimate goal of processing information. [2]

In a vending machine, the customer can arrange the articles in this context using a PDA without being assigned to the machine. Therefore, counting cunning on a machine creates a multifaceted character. As sensor fees continue to fall, it is imperative to equip an entire office with sensors in each rack that is opened or packed. Programming modules and settings also require occasional updating. These considerations are crucial for retailers looking to update existing vending machines to the currently connected world. [3]

The new era of intelligent machines offers huge open doors to business change through the Internet of Things (IoT) and cloud-based progress. World Cup resellers and administrators can expect increasingly compelling approaches to attract customers, grow business and save money through remote administration and preventative maintenance. The Guided Information Survey will help them improve racing cars and inventories in each area and gain important experience in the feasibility of progress, estimation, area, climate, season and various elements. [1].

2.3 Types of Vending Machine

Vending machines (VMs) are divided into different types because they are delivered to different points and therefore VM applications are rarely available in the market [3]. Vending machines offer various things, such as snacks, drinks, water, tickets and other things. The term "to distribute" is referred to as "to be discarded by agreement". As a result, things equipped for distribution are called "vendibles". This means that things or administrations that can be sold are considered as potential sellers. Groceries, snacks, fuel, ATMs, appointments for vending any type of administration, and queries for vending any type of property: They could all be seen as "sellers" to a halfway business that highlights a pharmacy, the repair doctor's recommended medication and prescription drugs, [2]

Within these first-class innovations, information and correspondence structures in the customer environment are negligible. In addition to supply chain management (SCM), IoT can be used in a similar way for various applications such as therapeutic administration, public services, transport, control, etc. In addition, the term "thing"

was redesigned as innovations progressed. The main goal of gathering information using the Internet of Things is the credibility of the foreclosure and foreclosure of characteristic VM parameters, e.g. Checking the element in the machine so that when the machine is almost exhausted, the machine is probably finished at this point with the necessary stock and stuff. It is also possible to test the frequency that the machine is likely to be used, depending on the time. If the customer inserts the coin into the World Cup, for example to buy a can of Coca Cola, there is a possibility that the person will insert the coin into the machine to buy Coca Cola, at which time the introduction of the coin can be recognized and identified by of an infrared (IR) sensor. There are several types of vending machines that this exploration adventure wants to highlight as a necessity.

2.3.1 Automatic Paper Vending Machine

Let the manufacturer know that the use of this article for the exam is predetermined and that his rationale develops primarily in places such as educational organizations, government jobs, and so on. At the same time, time is an important issue that one does not want to waste in any capacity. In stationary stores, buying paper during the growing period is a difficult task, and checking paper that is pre-parked will delay the extra time and you are likely to be able to count the paper incorrectly. In order to maintain strategic distance from these issues, the project is expected to be presented to the public as an "automated paper machine", which uses mechatronic sensors and microcontrollers in general. It will gradually and humbly criticize the inclusive generation and be valuable to the school and the school. The goal here is to move the cards into the box with the help of a single currency. This helps save extra time and invalidates the reliability of manual work. Figure 2.1 shows the planned VM paper format. [8]

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